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(54) Package for EMI, ESD, thermal, and mechanical shock protection of circuit chips.

(57) A package for integrated circuit chips, or other electrical devices, provides mechanical shock and thermal protection for the chips, and in addition, protects the chips from electromagnetic interference and electrostatic discharge. The package includes a printed wiring board base for reception of one or more circuit chips, and a conductive heat sink and cover. The conductive heat sink, in conjunction with a reference plane in the wiring board base, acts as an EMI shield for the chips. The heat sink is covered with an insulating layer, on top of which, a conductive coating is placed. The conductive coating is electrically connected to the reference plane, and the two act to protect the chips from electrostatic discharges. Compliant pads support the chips, and a thermally conductive elastomer can be placed on top of each chip between the chips and the inner top surface of the heat sink. The chips are thereby held securely in position, and are thermally connected to the heat sink.

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Claims

1. A package for one or more electrical devices comprising:
a housing for reception of at least one electrical device;
means on said housing to direct heat away from a received electrical device;
means on said housing to compliantly and securely hold a received device in position to protect a received device from mechanical shock;
means on said housing to shield a received device from electromagnetic interference, and conversely, to shield the exterior environment from the electromagmetic emissions from a received device; and,
means on said housing to shield a received device from electrostatic discharge.

2. The package of claim 1, wherein said housing includes a sealed enclosure for reception of at least one electrical device.

3. The package of claim 1, wherein said means on said housing to direct heat away from a received electrical device comprises a heat sink and means to thermally connect said heat sink to a received electrical device.

4. The package of claim 3, wherein said means to thermally connect said heat sink to received electrical device comprises a thermally conductive material disposed between said heat sink and a received electrical device.

5. The package of claim 1, wherein said means to compliantly and securely hold a received device comprises at least a first compliant pad means dispcsed between a base of said housing and a received device.

6. The package of claim 5 further including at least a second compliant pad means disposed between an inner top surface of said heat sink, and a received device.

7. The package of claim 6, wherein said second compliant pad means is formed from thermally conductive material.

8. The package of claim 1, wherein said means on said housing to shield a received device from electromagnetic interference comprises:
a base member including an electrically conductive ground plane; and,
an electrically conductive cover member mechanically and electrically connected to said base member to form a shielded enclosure for a received device.

9. The package of claim 8, wherein said means on said housing to shield a received device from electrostatic discharge comprises:
an insulating layer of material disposed on an exterior surface of said conductive cover member; and,
a layer of electrically conductive material disposed on said insulating layer, and electrically connected to said base member.

10. A package for one or more electrical devices, such as integrated circuit chips, comprising;
a housing including a base member and a heat sink cover member, said heat sink being made of electrically conductive material, and being mechanically attached to said base member, and electrically attached to a conductive layer in said base member, to form an enclosure for a received electrical device which shields a received device from electromagnetic interference, and shields the external environment from electromagnetic emissions generated by a receive device;
compliant means disposed on said base member for supporting a received device in a mechanical shock protected manner;
means to thermally contact said heat sink to a received device to provide protection of a received device from extreme temperatures; and,
an insulating layer of material disposed on an exterior surface of said heat sink, and a conductive layer of conductive material disposed over said insulating layer, and electrically connected to said base member to provide protection of a received device from electrostatic discharge.

of the invention, there is illustrated in FIG. 1, an integrated circuit package 10, which includes a base 12, and a combination heat sink and cover 14.

Base 12 is preferably formed from a printed wiring board 16, which is a layered substrate having a conductive layer 18 disposed in the middle thereof that forms a "reference plane". A plurality of support pads or blocks 20 can be disposed beneath the four corners of board 16, if desired.

Disposed on a top surface 22 of board 16, are one or more integrated circuit chips, or other electrical devices, 24. It will be understood that package 10 can be sized to accommodate any number or size of chips or devices. Further details of the chip mountings are illustrated in FIG. 2, and it will be understood that each of the chips includes a plurality of conductor leads (not shown) for electrically connecting them to circuitry in printed wiring board 16.

Also disposed on top surface 22, and generally around its periphery, is a narrow rectangular frame shaped conductive metal strip 25, on top of which is disposed, a similar shaped strip of conductive material 26, which surrounds the mounting area for chips 24. Conductive material 26 is preferably compliant, and can be a spring metal, or conductive elastomer, for example. This acts as an electrical gasket for the interface between heat sink 14 and base 12, and will be discussed in further detail below. A plurality of apertures 28 are disposed in compliant strip 26 at its corners that also pass through board 16 to receive mounting screws or bolts for attaching heat sink 14 to base 12.

Turning now to FIG. 2, package 10 is shown in greater detail. As illustrated, heat sink 14, which is constructed of a conductive material such as aluminum, preferably includes a plurality of heat radiating fins 30. It should be understood that other types of radiating elements could be formed on heat sink 14 if desired, or if liquid cooling is employed, no heating radiating elements at all are necessary. Disposed on all exterior surfaces of heat sink 14, including fins 30, is a first layer or coating 32 of electrical insulating material. A second layer or coating 34 is placed over insulating layer 32, and is formed from any suitable type of conductive material. Conductive layer 34 provides a surface separate from heat sink 14 for the accumulation of static charge, and thereby provides protection of chips 24 from electrostatic discharges.

When heat sink 14 is assembled to base 12, an integral depending peripheral rim or flange 36 of heat sink 14 engages compliant conductive strip 26, and forms a sealed area 38 for chips 24. A plurality (one shown) of bolts or screws 40, and corresponding nuts 42 are employed for securing heat sink 14 to base 12.

Conductive metal strip 25 is formed integrally with a plurality of conductive vias 46 that pass through apertures 28 in base 12. Vias 46 electrically contact reference plane conductive layer 18, and further extend to the bottom surface of wiring board 16, where small conductive areas 48 are formed for electrically contacting nuts 42.

Compliant conductive layer 26 and metal strip 25 serve to electrically connect heat sink 14, conductive coating 34, and reference plane 18 to thereby provide an enclosure for chips 24, which is shielded both from electromagnetic interference, and from electrostatic discharge. Conversely, the exterior environment is shielded from EMI emissions from the chips 24. In addition, the compliant nature of layer 26, helps insure that chip area 38 will be sealed from external dirt, moisture, etc.

Chips 24 are preferably supported on wiring board 16 by a plurality of compliant pads or cushions 50 which are placed on top surface 22 beneath each of the chips. A thermally conductive compliant cushion 52 is preferably disposed on top of each chip 24, and engages an inner top surface 54 of heat sink 14 when the same is secured to base 12. Cushion 52 not only insures that good thermal contact will be made between chips 24 and heat sink 14, but also insures, in conjunction with support pads 50, that chips 24 will be held securely in position, and insulated from mechanical shock. Alternatively, cushion 52 can be eliminated if desired, and the heat sink dimensions adjusted so that inner top surface 54 will directly contact chips 24 when heat sink 14 is in position.

From the foregoing, it may be thus seen that package 10 is constructed in a simple and compact manner, and provides excellent mechanical, thermal, and electrical protection for chips 24. Heat sink 14 acts to draw heat away from the chips, to hold the chips securely but compliantly in position, and to provide a sealed enclosure for the chips as well. In addition, because it is made of electrically conductive material, heat sink 14, in conjunction with reference plane conductive layer 18, also acts as an EMI shield for chips 24, and in conjunction with conductive coating 34, acts as an ESD shield for chips 24.

Although the invention as been disclosed in terms of a preferred embodiment it will be understood that numerous variations and modifications could be made thereto without departing from the true spirit and scope thereof as defined in the following claims.

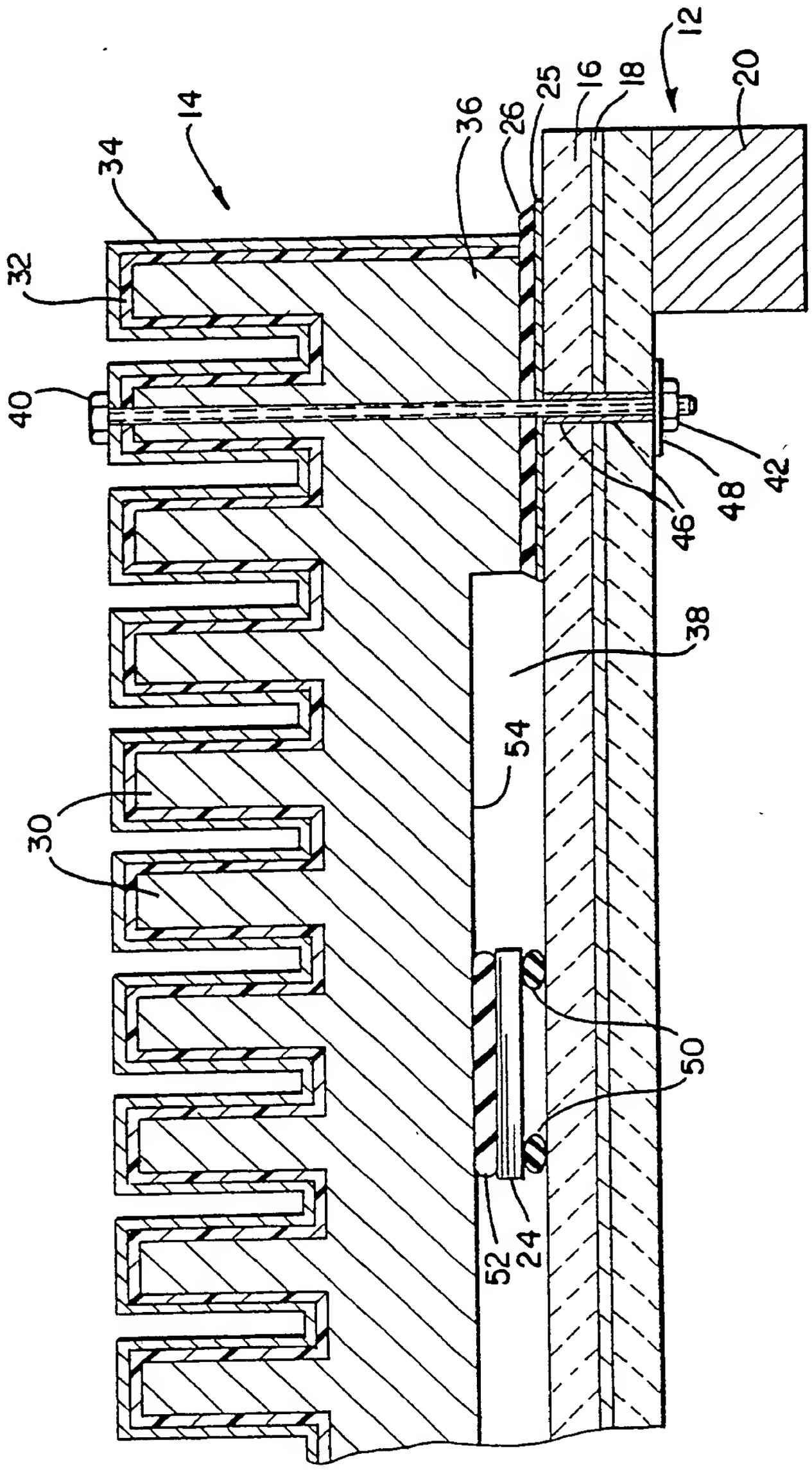

FIG 2

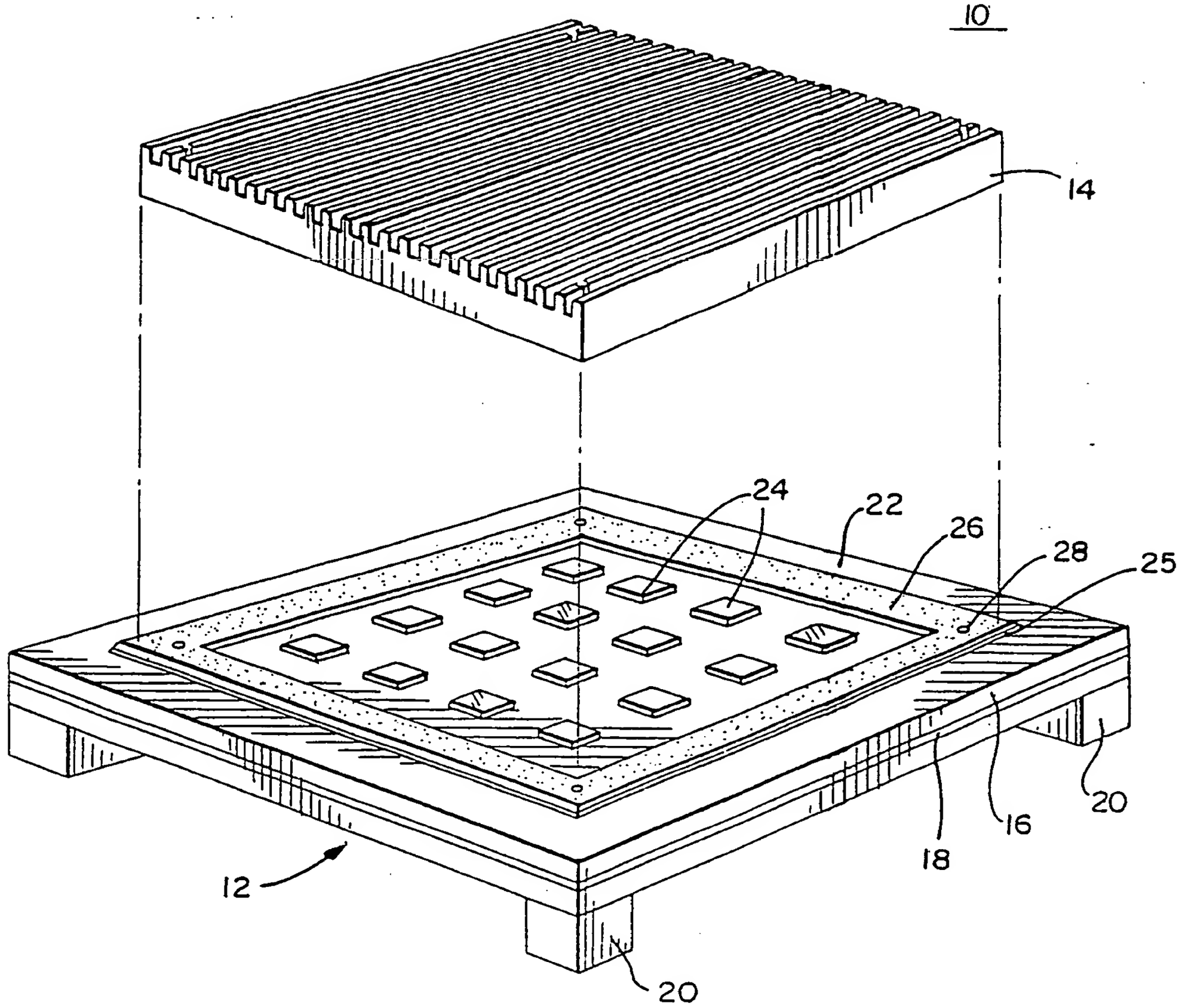

FIG 1

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 30 4081

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 30, no. 10, March 1988, pages 310-311, Armonk, New York, US; "Thermal enhancement and mechanical protection cover" ---	1,2	H 01 L 23/56 H 01 L 23/40
A	US-A-3 303 392 (GENERAL SYSTEMS) * Claim 4 * ---	1,3	
A	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 9, no. 277 (E-355)[2000], 6th November 1985; & JP-A-60 120 541 (HITACHI MAIKURO COMPUTER ENGINEERING K.K.) 28-06-1985 ---	1,2,9	
A	PATENT ABSTRACTS OF JAPAN, vol. 9, no. 258 (E-350)[1981], 16th October 1985; & JP-A-60 106 150 (NIPPON DENSHIN DENWA KOSHA) 11-06-1985 ---	1,2,8	
A	EP-A-0 103 068 (SIEMENS) * Figures 1,2; claims 1,2,7 * ---	3-5	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	DE-A-2 749 848 (IBM) * Figure 2; claim 1 * -----	1-5	H 01 L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	03-09-1990	DE RAEVE R.A.L.

EPO FORM 1503 03.82 (P0401)

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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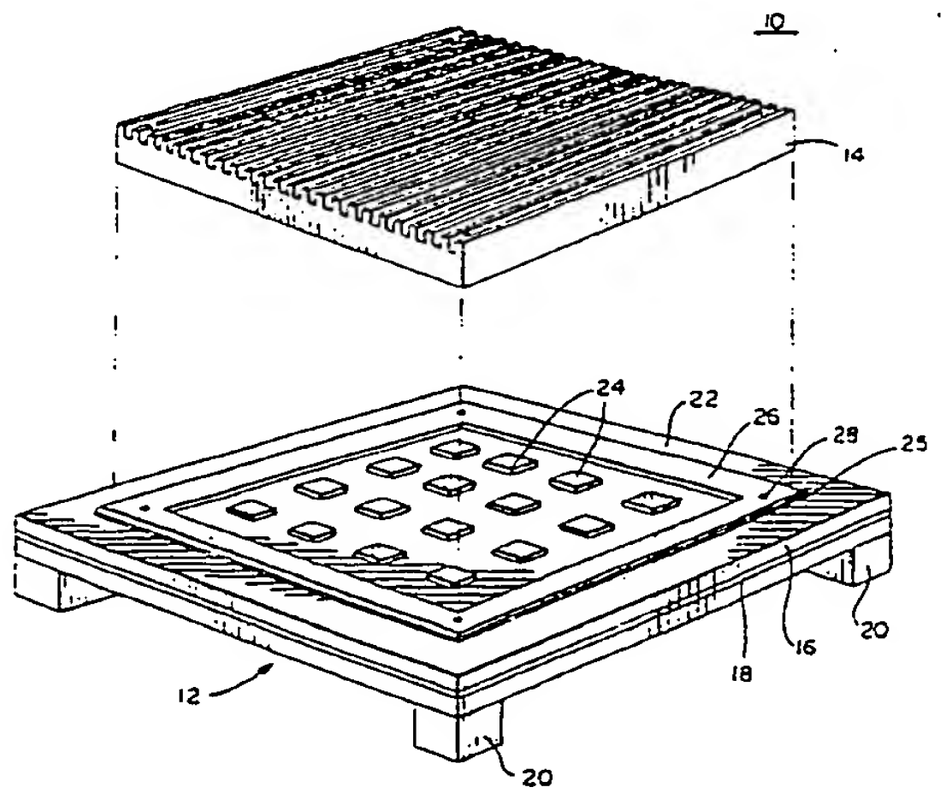

FIG 1

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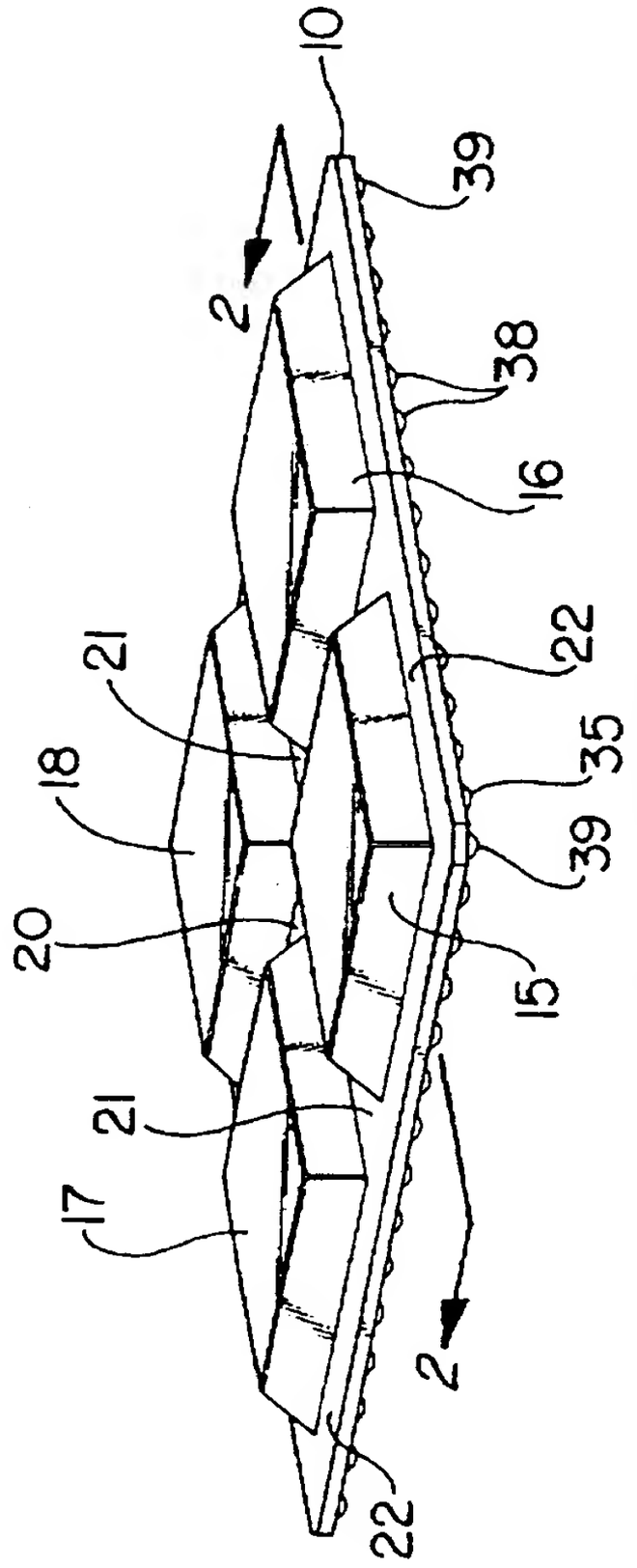
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FIG. 1

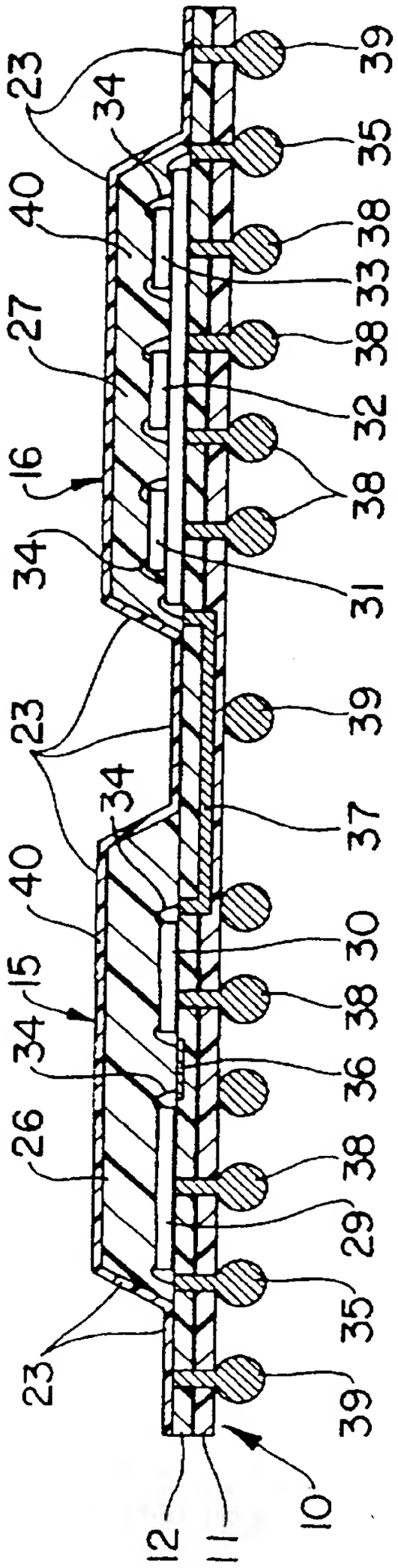
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FIG. 2